RESEARCH HIGHLIGHT

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ICE DAMMING FIELD RESEARCH

INTRODUCTION

Ice damming is a problem that annually affects a large number of houses in Canada. It can cause water leakage inside the house and can present a danger of falling ice. It may also affect the service life of roofing materials and components.

Ice damming arises from differential melting and freezing of snow on a roof. When reduced to its simplest form, the formation of rooftop ice dams requires three elements:

1. Rooftop snow
2. Upper areas of roof at or above the temperature at which snow or ice melts
3. Lower areas of roof that are below the temperature at which water freezes

If any of the above elements is not present, ice dams will not form. It is not uncommon for building owners to attempt to resolve ice damming problems through the elimination of items one or three of the above list (e.g., using a snow rake to remove the accumulated snow or electric cables to melt problematic ice). Such methods can reduce or eliminate the leakage in the short term but, because they do not address the cause of the melting and freezing, they often do not provide a long-term solution. In addition, they frequently do not address the durability issues caused by ice buildup on the roofs. The best solution is to change attic conditions to prevent ice damming from occurring.

Previous research in New Hampshire (Tobaisson 1994) and Ottawa (Scanada 1996) indicates that higher attic temperatures may be a predictor of ice dam formation.

RESEARCH PROGRAM

CMHC's *About Your House* "Attic Venting, Attic Moisture and Ice Dams" (CMHC 2004 A) suggests that the preferable method to eliminate ice damming problems is to reduce the temperature differential across the roof. This Research Highlight describes the conditions in four low-rise condominium complexes and one single-family house in Ottawa, Ont. Each site has suffered severe ice damming in the past. The repair strategy at each site primarily focused on reducing air leakage into the attic from the house. The success of these trial repairs was monitored by attic temperatures and visual indicators.

RESEARCH RESULTS

There was no shortage of air-leakage sites in these buildings despite, for instance, the efforts of seven previous consultants on Site 1. However, even this current research project did not achieve a perfect attic floor–air seal. In some cases, the complexity of the roof shapes made effective air sealing near impossible, although removal of the roof sheathing might have led to even more effective solutions (at a higher cost). In other cases, the sealing contractor tried but was unable to find and plug all leaks. There was no quantification in this project of the house-to-attic leakage area or the effects of attic floor air sealing.

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When assessing the success of the remedial measures, the other problem was that ice damming does not occur on any predictable schedule. The winter following the remedial measures was cold and near snowless in Ottawa. Houses with a normal tendency to ice damming did not produce icicles the winter of 2004. The contractor measured attic temperatures as an indicator for the propensity of ice dam formation. The contractor also calculated an attic temperature index, which was the ratio of the difference of attic and outside temperatures compared to the indoor-to-outside temperature difference. An attic temperature index of near zero was optimal. Using this index helped to compare the performance of the attics under different outside temperature conditions. Despite the comparison of temperature data, the true proof of success is the absence of ice dams, and this proof awaits appropriate climatic conditions in some future winter.

Here are the general results from the five locations.

	Air sealing performed	**Visual difference following remediation?**	**Temperature difference?**	**Temperature index difference?**
Site 1 townhouses	Party wall, discontinuous floors, chimney chases	Yes, reduced ice development	Repaired attic temperatures showed small decrease	Attic temperature index showed small decrease
Site 2 townhouses	Party wall, chimney area, penetrations, etc.	No significant icing on either house	Repaired attic had higher temperatures after work	Temperature index increased in repaired attic
Site 3 townhouses	Kneewalls, party walls, penetrations	No significant icing on either house	Mixed results	Temperature indices rose, but less in repaired attic than control attic
Site 4 townhouses	Penetrations, attic hatches, dryers venting into attics	No significant icing on either house	Repaired unit showed lower attic temperatures	Repaired unit showed lower attic temperature index
Site 5 single-family house	Cathedral ceilings, exterior walls, near the chimney, balloon-frame cavities (insulation added as well)	Inconclusive due to winter not conducive to ice damming	Mixed results. No apparent temperature decrease following air sealing	Index increased after sealing but decreased following the addition of insulation

The results are perplexing. While the airsealing work may not have been perfect, it was substantial and has reduced the influx of house air and heat into the attic. That being the case, there should have been either reduced attic temperatures or a lower temperature index, or both, in the repaired attics. It is not clear why this did not happen. Perhaps air leakage is very small amongst the sources of house-heat loss to the attic. Especially in the townhouses, conductive losses from party walls and chimneys may overwhelm the energy contributions from air leakage. If this were true, then the reductions due to lower air leakage would not make a significant difference in the attic temperatures. Alternatively, it may be that a temperature measured in the centre of the attic may not be significant, as the leakage and conduction sites melt the snow at specific areas of impingement.

See the CMHC Research Highlight on roof melt patterns at:

http://www.cmhc.ca/od/?pid=63465 (CMHC 2004 B)

If this were the case, the real improvement in ice dam prevention would not be evident from the single attic temperature measurement taken in these houses.

Implications for the building industry and consumers

Due to the inconclusive nature of the results, there are no new recommendations based on these research findings. Anecdotally, and in theory, an attic well-separated from the house by a good air barrier and insulation should not have a serious problem with ice damming. Proving this theory is more difficult than first imagined and awaits the proofs of another round of research.

REFERENCES

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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